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## CORRESPONDENCE

*Editor of the American Naturalist:*

The Flying Fish problem, discussed by Lieut. Col. C. D. Durnford in the *American Naturalist* for February (page 65), seems to be now reduced to a question of keenness of eyesight. Do the wings or pectoral fins of this fish in flight move so swiftly that the motion cannot be seen? or do they not move at all?

The initial start of the fish on leaving the water is clearly due to the swift motion of the tail. When the tail is moving, either at the initial leap from the water, or when by skimming along the surface the tail touches the water, the wings are seen to be in rapid vibration. When the tail is free from the water, the wings are outspread fan-fashion and seem to be held firmly and at rest without vibration, to be folded when the fish drops into the water. It takes strong muscles to hold the wings taut; we may admit that the fish has these; it would take stronger muscles to cause the fish to move through the flapping of the wings.

The problem is this: Does the fish flap its fins? In the view of Col. Durnford it does. In his view the vibrations are so rapid that to most observers they cannot be seen, except at the beginning or end of the flight, when the tail is in the water.

In the view of others, the wings are not flapped at all. When the fish rises from the body the tail is flapped, which flaps the body and causes the wings to vibrate up and down as the body itself is agitated.

The writer has watched many hundreds of flying fishes. His best opportunity has been in a small boat in the Santa Catalina Channel, where the largest of the known species, *Cypselurus californicus*, over a foot long, flies by the hundred in March. He is reasonably sure, so far as any man can trust his own eye, that the *wings do not move* when the fish is sailing, and that that portion of the fish's flight is on the principle of the aeroplane.

The following note was made by the writer in 1880:

"Their movements in the water are extremely rapid; the sole source of motive power is the action of the strong tail while in the water. No force is acquired while the fish is in the air. On rising from the water, the movements of the tail are continued until the whole body is out of the water. While the tail is in motion, the pectorals seem to

be in a state of rapid vibration, but this is apparent only, due to the resistance of the air to the motions of the animal. While the tail is in the water, the ventrals are folded. When the action of the tail ceases, the pectorals and ventrals are spread and held at rest. They are not used as wings, but act rather as parachutes to hold the body in the air. When the fish begins to fall, the tail touches the water, when its motion begins again, and with it the apparent motion of the pectorals. It is thus enabled to resume its flight, which it finishes with a splash. While in the air it resembles a large dragon-fly. The motion is very swift, at first in a straight line, but later deflected into a curve. The motion has no relation to the direction of the wind. When a vessel is passing through a school of these fishes, they spring up before it, moving in all directions, as grasshoppers in a meadow."

Very truly yours,

DAVID STARR JORDAN

February 23, 1907